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REMAINING OVERDELIVERIES

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Title :

ATFM STUDIES Remaining Overdeliveries

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Abstract : This document describes an ATFM (Air Traffic Flow Management) study conducted by the Centre of Expertise Flight Data Research on behalf of the CFMU (Central Flow Management Unit) in to evaluate the performance of the current CFMU Operations and to evaluate the Slot Allocation process by analysing the remaining overdeliveries on regulated sectors

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ABBREVIATIONS

1. Introduction

This document describes an ATFM (Air Traffic Flow Management) study conducted by the Centre of Expertise Flight Data Research on behalf of the CFMU (Central Flow Management Unit).

The objectives of this study were to evaluate the performance of the current CFMU Operations and to evaluate the Slot Allocation process by analysing the remaining overdeliveries and overloads on regulated sectors. The objectives were defined by CFMU and EEC representatives and were approved by the directors of the CFMU and the EEC in a meeting held in Brussels on the 26th of February 1997.

The study was divided in two phases :

- During the first phase, the study sized the problem of the overdeliveries during the 1996 summer period and tried to identify repetitive problems.
- During the second phase, the study analysed remaining overloads by comparing the Actual Time Over (ATO) the regulated location provided by ACT (ACTivation message) with the Calculated Time Over (CTO) the regulated locations calculated by CASA.

  The study analysed 5 regulations :

  1. UGW of the 12/09/96,
  2. KUD of the 06/07/1997,
  3. URUY of the 06/07/97,
  4. UFXF of the 06/07/1997,
  5. UA of the 11/07/1997.

2. Methodology

The statistics of the CFMU for the summer 1996 were used during the first phase to detect the remaining overdeliveries on regulated sectors, to study their frequency, to size the problem and to analyse it.

In a first step, the study counted the number of overdeliveries computed by CASA on the regulated demand. Then, the rate and the duration of the regulations were taken into account.

For the second phase, detailed analysis of some regulations were made using archives of TACT and data issued from COURAGE provided by the french administration (SCTA). These data contained the ACT message issued by the French system CAUTRA.

3. Results of the first phase

For each regulation, in the following tables, the number of hours are shown when the hour overdelivery exceeds the hour capacity by a certain percentage

3.1.Global Results

The global results of the first phase are given in the table below :

	Nb of reg	>=20% *	>= 40 % **
June	39	115	104
July	45	335	114
August	42	292	90
September	36	342	61
TOTAL	162	1184	369

* number of hours with overdeliveries >= 20%

** number of hours with overdeliveries >= 40%

This table summarizes all the regulations having overdeliveries during the summer 1996 without taking into account the rate.

3.2 Rate

When the rate is equal or lesser than 10 aircraft an hour, the results are shown in the table below :

	Nb of reg	>=20%	>= 40 %
June	23	274	98
July	27	259	103
August	17	236	80
September	11	173	51
TOTAL	68	942	332

When the rate is higher than 10 aircraft an hour, the results are shown in the table below :

	Nb of reg	>=20%	>= 40 %
June	16	41	6
July	28	104	11
August	25	56	10
September	25	69	10
TOTAL	94	272	37

For summer 1996, 942 overdeliveries out of 1184 were due to regulations with a rate less than 10/60.

3.3. Duration

The duration of the overdeliveries was compared to the total duration of the regulation. The regulations with a short duration (when the regulations lasted less than 5 hours for the summer 96) were not taken into account.

Regulation	20%<=Time <40%	40%<=Time <60%	DURATION(h) Of regulation	%of overdeliveries GT20	%of overdeliveries GT40	%of overdeliveries GT60	%of overdeliveries GT80	RATE
LGATD	27	2	1429	2%	0%	0%	0%	15
LIMLAR	17	-	1745	1%	0%	0%	0%	16
LGD3	15	-	600	3%	0%	0%	0%	19
LBWR	21	1	502	4%	0%	0%	0%	15
LGIRG	28	1	651	4%	0%	0%	0%	11
LGATG	7	-	1576	0%	0%	0%	0%	27
LGTSG	7	-	293	2%	0%	0%	0%	13
TOTAL	122	4	6796	2%	0%	0%	0%	

After having removed the short duration, 7 regulations remained

5 Greek regulations

1 Italian regulation

1 Bulgarian regulation

These results are summarized in the table below:

It can be noted that the highest percentage of overdeliveries greater than 20% is 4% .

3.4. Period End Slots

The study indicated that for all the regulations analysed the overdeliveries were found essentially at the end of the periods.

These overdeliveries slots are known in CASA as Period End Slots (PES).

The Period End Slos are slots allocated by CASA, right after the end of the regulation because it could not find any slot available before.

The table below showed for example that the regulation of the French traffic volume URUY was activated from 10h30 to 14h00 and the overdeliveries were Period End Slots.

Rate	Stat	Id	ETOT	CTOT	ETO	CTO
NORM	ALLO	BAW83MJ	13:00	13:00	13:57	13:57
NORM	ALLO	SAB875	12:50	13:48	13:01	14:00
OVER	ALLO	SBE141	12:05	12:17	13:47	14:00
OVER	ALLO	UKA919	12:40	13:10	13:29	14:00
OVER	ALLO	CSDNA	12:57	13:27	13:29	14:00
OVER	ALLO	AFR2002	13:40	13:46	13:53	14:00

The problem was investigated in ordrer to clarify whether the regulation period was too short or if a problem with the QC tool occured.

The QC toom is counting the PES in the last period segment of the regulation and is detecting an overdelivery.

The TACT system is monitoring the PES and the CEU Air Traffic Flow Controllers are well aware of their presence.

The CEU working procedure request that in case of PES, the regulation is extented with a rate depending on the capacity available during the period zfter the end of the regulation.

In case of degrouping of combined sectors, the new capacity may be significantly higher than the rate of the regulation (ie 60 for 30)

In that case, these PES are not a problem anymore and the FMP request that the regulation is not extended. There is enough capacity left to cope with these flights, even in term of bunching.

Provided that the PES are dualy coordinated with FMP's, it can be consider that the remaining overdeliveries as QC counting effect are kept as a warning for CEU.

4. Results of the second phase

4.1. Analysis of the regulation UGW activated the 12/09/96

4.1.1.General

This regulation was activated from 04H30 to 13H30,

the rate was 60/60,

432 slots were allocated,

110 slots were not used,

16 slots were allocated but no traffic were found in the data provided by the SCTA

848 minutes of delays.

32 flights were exempted

4.1.2. Comparison ETO/CTO

The table below shows the distribution of ETO, CTO and ATO :

	ETO	CTO	ATO
0430 - 0530	36	29	28
0530 - 0630	50	57	53
0630 - 0730	46	39	38
0730 - 0830	49	53	49
0830 - 0930	48	47	44
0930 - 1030	44	43	47
1030 - 1130	51	53	52
1130 - 1230	61	57	51
1230 - 1330	52	52	50

This regulation was activated during 9 hours and the capacity, even with overdeliveries found in CFMU report, was never exceeded, except during one hour between 11h30 and 12h30.

6% of the flights were Late filer

7% of the flights were Late updater

63% were flights combined in several regulations

4.1.3. Comparison CTO/ATO

The comparison between the number of CTO and the number of ATO showed that there is usually less number of ATO than number of CTO. That was explained by the number of flights not found in the data given by SCTA , 16 aircraft and 3 were flights combined in several regulations.

4.1.4. Compliance with CTO - 5 and CTO +10

It can be noted that 223 traffic out of 430 complied their « slot » between CTO-5 minutes and CTO + 10 minutes, that is 56,6%. It means also than more than 40% of the traffic did not complied with their slot.

4.2. Analysis of the regulation KUD activated the 06/07/1997

4.2.1.General

This regulation was activated from 06H00 to 09H30,

the rate was 26/60,

97 slots were allocated,

1 slot was not used,

1 slot was allocated but no traffic was found in the data provided by the SCTA,

1900 minutes of delays.

17 flights were exempted.

4.2.2. Comparison ETO/CTO

The table below shows the distribution of ETO, CTO and ATO :

	ETO	CTO	ATO
before 0600			3
0600 - 0700	41	25	23
0700 - 0800	28	25	22
0800 - 0900	19	23	27
0900 - 0930	7	25	15
after 0930			7

During the regulatien, the demand exceeded the capacity(demand = 41 [first hour] and 28 [second hour] vs capacity = 26), but CASA computed the slots in the frame of the capacity. During the last half-hour, the demand was in fact 22 aircraft after regulation till 09h00 and CASA allocated 25 slots.

9 overdeliveries were found at the end of the period.

12 % of the traffic was composed of Late filers

19% of the flights were Late updaters.

97 % of the traffic was flights combined in several regulations

4.2.3. Comparison CTO/ATO

The number of CTO and the number of ATO were quite balanced, except between 08h00 and 09h00 (where there is an overload of 15%) and at the end of the regulation.

Only one combined traffic(for which this regulation was the most penalizing) was not found in the SCTA list .

4.2.4. Compliance with CTO - 5 and CTO +10

More than 42% of the traffic complied with CTO - 5 and CTO + 10(that is 41 out of 97) and 41% arrived earlier than their CTO -5.

4.3. Analysis of the regulation UFXF activated the 06/07/1997

4.3.1.General

This regulation was activated from 10H30 to 14H00,

the rate was 32/60,

103 slots were allocated,

24 slots were not used,

4 slots were allocated but no traffic were found in the data provided by the SCTA,

437 minutes of delays.

7 flights were exempted.

4.3.2. Comparison ETO/CTO

The table below shows the distribution of ETO, CTO and ATO :

	ETO	CTO	ATO
before 1030	10		1
1030 - 1130	35	28	29
1130 - 1230	20	30	25
1230- 1330	21	16	14
1330-1430	24	33	28
after 1430			6

For a capacity of 32 aircraft per hour, it can be noted that the demand was exceeding the capacity during the first hour. From 12h30 to 13h30 meanwhile the demand is 21/60, CASA allocated only 16 slots and during the following hour, the demand is 24/60 and CASA allocated 33 slots due to forcing of combined flights Between 11h30 to 12h30 and 13h30 to 14h30, for one third of the flights, this regulation was the most penalizing regulation, and between 12h30 to 13h30, this regulation was the most penalizing regulation for only one flight out of 16.

7% of traffic were Late filers

7% of the flights were Late updaters

90% of the flights were combined in several regulations.

4.3.3. Comparison CTO/ATO

The comparison between the number of CTO and the number of ATO showed that the traffic was quite well balanced.

4.3.4 Compliance with CTO - 5 and CTO +10

59 flights out of 103 complied their « slots », that represents more than 57%, but as for the other regulations, 22% of the aircraft arrived earlier than their CTO - 5.

4.4. Analysis of the regulation URUY activated the 06/07/1997

4.4.1.General

This regulation was activated from 10H30 to 14H00, the rate was 50/60,

176 slots were allocated,

4 slots were not used,

3 slots were allocated but no traffic were found in the data provided by the SCTA,

1138 minutes of delays.

21 flights were exempted

4.4.2. Comparison ETO/CTO

The table below shows the distribution of ETO, CTO and ATO :

	ETO	CTO	ATO
before 1030	19		4
1030 - 1100	20	27	20
1100 - 1200	62	48	52
1200 - 1300	51	52	53
1300 - 1400	26	52	40
after 1400			7

The demand was exceeding the capacity during the two first hours, and the slots allocated by CASA are in the frame of this capacity. From 10h30 to 11h00, there are more CTO than ETO due to demand before 10h30 shifted by the ATO into the regulated period

6 % of flights were Late filers

13% of the flights were Late updaters.

88 % of the aircraft were in combined regulations.

4.4.3. Comparison CTO/ATO

An overload of 10% was found between 11h00 and 12h00.

4 overdeliveries were found at the end of the regulation.

3 flights were in the slot list but did not appeared in the SCTA list, for 2 flights combined, this regulation was the most penalizing.

4.4.3. Compliance with CTO - 5 and CTO +10

More than 45% of the traffic (80 out of 176) complied with their slots, but more than 42% arrived earlier than their CTO -5.

4.5. Analysis of the regulation UA activated the 11/07/1997

4.5.1.General

This regulation was activated from 05H00 to 08H00

the rate was 31/60,

88 slots were allocated,

1 slot was not used,

7 slots were allocated but no traffic were found in the data provided by the SCTA,

1043 minutes of delays.

21 flights were exempted.

4.5.2. Comparison ETO/CTO

The table below shows the distribution of ETO, CTO and ATO :

	ETO	CTO	ATO
before 0500	9		1
0500 - 0600	32	30	29
0600 - 0700	35	31	25
0700 - 0800	28	34	28
after 0800			5

For a capacity of 31/60, the demand was higher than the capacity during the two first hours. CASA allocated the slots in the frame of the capacity, except during the last hour where it can be noted that there are 3 CTO more than the capacity. When having a look at the slot list, there are 4 overdeliveries, 3 at the end of the period.

11% of the aircraft were Late filers

25% of the flights were Late updaters.

44 % were flights combined in several regulations.

4.5.3. Comparison CTO/ATO

As for other regulations, there are less ATO than CTO; 7 combined flights for which this regulations was the most penalizing were not found in the data provided by SCTA.

4.5.4. Compliance with CTO - 5 and CTO +10

63 flights out 88 complied the rule CTO - 5 and CTO + 10, that represents more than 70%. But 22% arrived earlier than CTO - 5.

5.General comparison ETO/CTO/ATO

The table below summarises the comparison between ETO (traffic demand), CTO (regulated demand), ATO (actual traffic) and the capacity for the regulations used during the second phase :

	ETO/CAPA	CTO/CAPA	ATO/CAPA	CAPA
ugw1	0,60	0,48	0,47	60
ugw2	0,83	0,95	0,88	60
ugw3	0,77	0,65	0,63	60
ugw4	0,82	0,88	0,82	60
ugw5	0,80	0,78	0,73	60
ugw6	0,73	0,72	0,78	60
ugw7	0,85	0,88	0,87	60
ugw8	1,02	0,95	0,85	60
ugw9	0,87	0,70	0,73	60
kud1	1,58	0,96	0,88	26
kud2	1,08	0,96	0,85	26
kud3	0,73	0,88	1,04	26
kud4	0,54	1,08	0,92	13
ufxf1	1,09	0,88	0,91	32
ufxf2	0,63	0,94	0,78	32
ufxf3	0,66	0,50	0,44	32
ufxf4	0,75	0,94	0,81	32
uruy1	0,80	1,08	0,80	25
uruy2	1,24	0,96	1,04	50
uruy3	1,02	1,04	1,06	50
uruy4	0,52	0,92	0,82	50
ua1	1,03	0,97	0,94	31
ua2	1,13	1,00	0,81	31
ua3	0,90	1,03	0,90	31
weighted average	0,86	0,85	0,81	

The difference between the CTO and ATO shows that about 5% of ATO are missing during the regulated periods, but they are usually found later on.

6. Conclusions

The objectives of this study were to evaluate the performance of the current CFMU Operations and to evaluate the Slot Allocation process by analysing the remaining overdeliveries and overloads on regulated sectors

This study was conducted in two phases:

- The first one to size the problem of the overdeliveries during the 1996 summer period and to try to identify repetitive problems.
- The second one, to analyse remaining overloads by comparing the Actual Time Over (ATO) the regulated location provided by ACT (ACTivation message) with the Calculated Time Over (CTO) the regulated locations calculated by CASA.

The study analysed 5 regulations :

1. UGW of the 12/09/96,
2. KUD of the 06/07/1997,
3. URUY of the 06/07/97,
4. UFXF of the 06/07/1997,
5. UA of the 11/07/1997

The study of overdeliveries and overloads leads to the following conclusions :

A large number of overdeliveries are found in regulation with low rate. These overdeliveries are a consequence of the measurement (2 flights in a regulation of 1 flight per hour give an overdelivery of 100%) and they must be disregarded.

A large number of overdeliveries in term of relative duration are also found in regulations with short duration, this has to be taken into consideration.

The number of relevant overdeliveries is very small, both in frequency and significance, especially if the Period End Slots are dualy coordinated with FMP's.

The number of ATO (count of actual traffic) and the number of CTO (count of regulated demand) are similar (about 5% of difference). In other terms, there are almost not overloads and on a global basis, the system is fuctioning correctly.

However, looking at individual flights, it has been shown that a significant number (from 22 to 42%) of flights absorbe, at least partly, their delays in flight (ATO< CTO - 5 minutes). This could lead to hourly overloads, even with a perfect slot delivery, or more likely more often, to short duration bunching. This could be the subject of another study.

ABBREVIATIONS

ACC	**Air traffic Control Centre**
ACT	**Activation Message**
ATC	**Air Traffic Control**
ATFM	**Air Traffic Flow Management**
ATM	**Air Traffic Management**
ATO	**Actual Time Over**
ATOT	**Actual Take Off Time**
CASA	**Computer Assisted Slot Allocation**
CAUTRA	**Coordonateur Automatique du Trafic Aérien**
CFMU	**Central Flow Management Unit**
COURAGE	**Calcul Optimisé des Ucesos et Recherche des Améliorations de Gestion de l'Espace**
CTO	**Calculated Time Over**
CTOT	**Calculated Take Off Time**
ETO	**Estimated Time Over**
ETOT	**Estimated Take Off Time**
SCTA	**Service du Contôle du Trafic Aérien**
TACT	**CFMU TACTical system**